

## PHYSIKALISCHES KOLLOQUIUM

### Sommersemester 2026

Das Kolloquium findet (soweit nicht anders angegeben) **jeweils montags um 14:15 Uhr im Röntgen-Hörsaal** des Physikalischen Instituts, Hubland Campus Süd, Universität Würzburg **und online via Zoom statt.**

Zugangsdaten siehe <https://www.physik.uni-wuerzburg.de/aktuelles/veranstaltungen-aus-der-physik/physikalisches-kolloquium/>

**06.07.2026**

Prof. Dr. Thomas Pfeifer

Max-Planck-Institute für Kernphysik, Heidelberg, Quantum Dynamics & Control

**Listening to the ultrafast chat of 2 electrons, and asking them about their physics life in intense laser fields**

#### **Abstract**

Electrons already taught us many physics lessons. To list only a few examples: Spectral analysis of flames, uncovering their discrete atomic energy levels, and the photoelectric effect, leading to the discovery of quantum mechanics, all the way to the laser principle along with its multitude of applications, among them quantum-optics science and technology. The Nobel Prize in Physics 2023 honored the making of extremely short, attosecond-duration flashes of light, opening a portal to exploring electrons in motion within atoms and molecules.

This talk focuses on some of our experiments using tools to measure (listen to), understand, and control/change (asking questions) fundamental electronic processes in atoms and molecules on ultrafast time scales. Employing intense short laser pulses (flashes) of light, the electronic levels within matter can be strongly modified, but then returned to their natural state within a few femtoseconds. These changes manifest in the electronic response and can be read out by spectroscopy, similar to Fraunhofer's approach of observing dark absorption lines in the solar spectrum. Our approach expands on this principle in the analysis of time-, and intensity-dependent spectral structures (line shapes), thus gaining access to the full quantum information, amplitude and phase, of quantum-dynamical modifications and thus changes of the electronic wavefunction. Starting our journey from two electrons in Helium, giving rise to Fano resonances, we extract the fundamental physical

mechanisms and afterwards apply them in quantum systems of increasing complexity. These experiments point towards a potential future vision: An ultrafast quantum computer based on atomic states as central (or even neural) processing units (CPUs/NPUs), programmed by intense fields of light.

Für die Dozentinnen bzw. Dozenten der Fakultät

Prof. Dr. Neuenfeld, Dr. Feichtner, Dr. Ünzelmann, Hr. Plote, Hr Schwarzkopf